

Public Plant Breeding: a Critical Component of Our Seed System

National CFAR 9/2015

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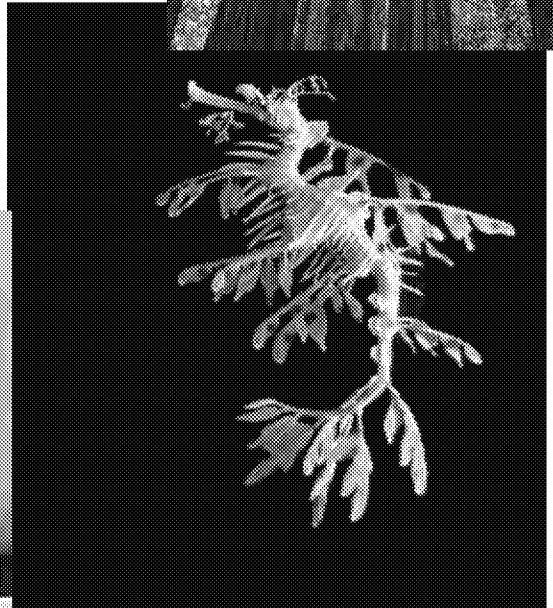
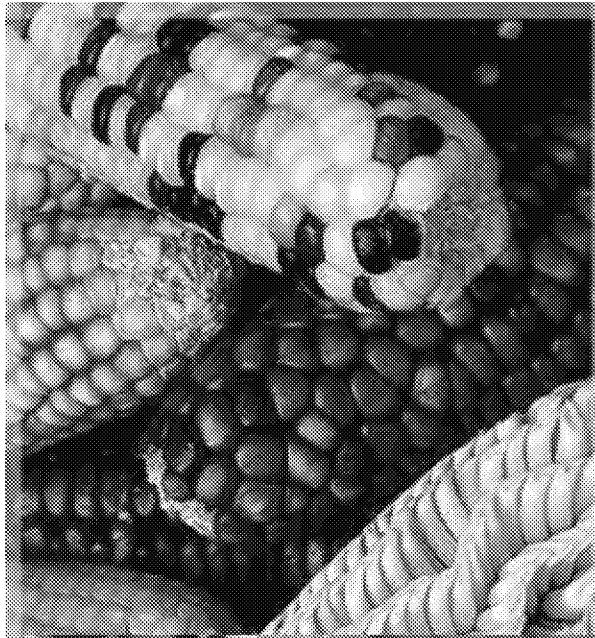


Goals

- What is plant breeding and what makes it important ?
 - Power and potential of plant breeding
- The three components of the US seed system
- Why are we talking about public plant breeding?



***The astounding diversity of life on earth is a result of the creative power of selection
(natural and artificial)***



Plant breeding a powerful technology

- If only selected plants intermate, allele frequencies will shift in the following generations.
- If the process is repeated for a number of generations, then
- **completely novel and sometimes unexpected phenotypes result.**
- It is incredibly powerful, precise, and predictable.



What is Plant Breeding

- The power and implications of plant breeding cannot be over emphasized.
- Plant breeding creates entirely new crops and even species.
- It is the base of the food system
- Plant breeding is place based – adapting crops to local environments and farming systems
- Plant breeders must breed for future growing conditions.
- **By predicting the future they create the future!**

The US Seed System

three complementary and necessary parts

- The commercial seed industry
 - Range in size from multinational to mom and pop
 - from global to local markets
- Plant breeding in the public sector
 - Land Grants
 - USDA-NIFA-ARS
- National Plant Germplasm System
 - USDA-NIFA-ARS
 - Network of repositories, scattered cross US
 - Interacts with germplasm banks around the world

The Seed System

three complementary and necessary parts

- The commercial seed industry
 - Tremendous investment in high value crops
 - Continues to consolidate to maximize efficiency
 - Consolidations sometimes result in low value crops and small markets being dropped.
- Plant breeding at the Land Grants
 - Severe downsizing (>30%) in last 20 years
 - Many crops have been dropped.
- National Plant Germplasm System
 - Tremendous pressure on system due to demands
 - Overstretched and underfunded.

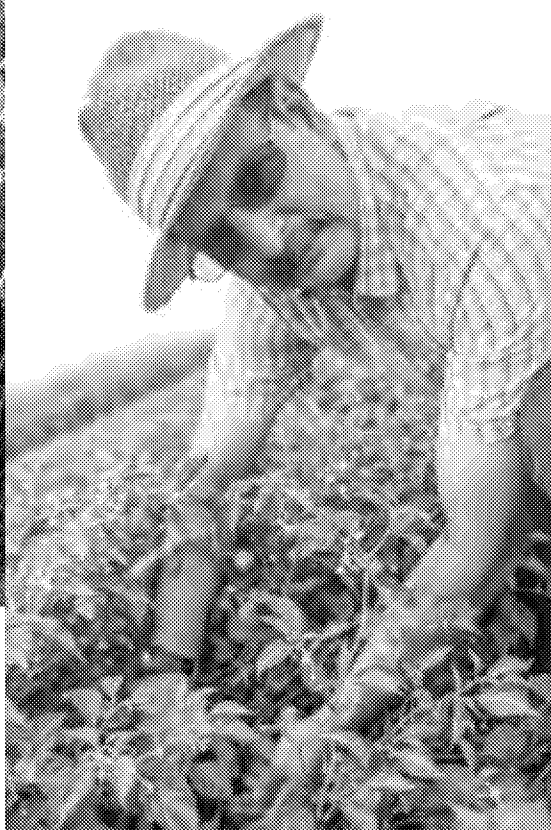
Trends

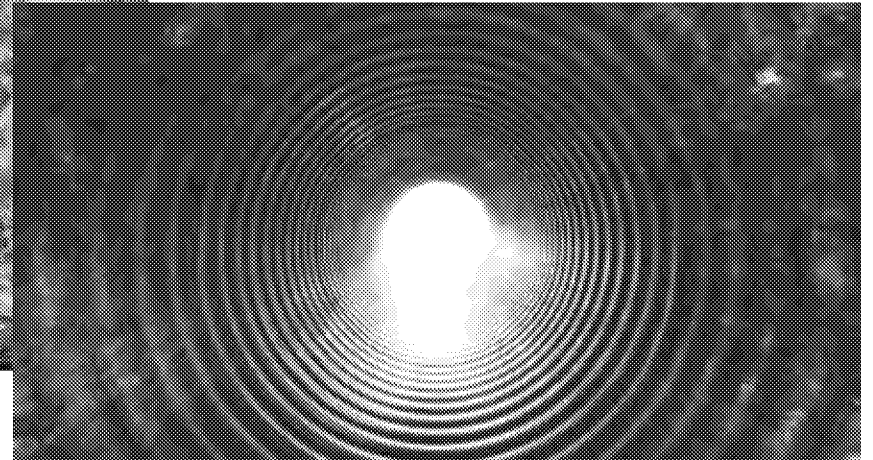
- The public sector has continued to lose plant breeding capacity over the last 30 years.
- Most of this loss is at the land-grants.
- USDA-ARS losses are somewhat less.
- Losses are due to declining state support for LGUs
- Lack of Federal funding directed toward plant breeding – Formula funds and NIFA-AFRI
- The situation is more dire than most know.

What is the state of public plant breeding today?

Variable – depending upon the crop, the institution, and the individual breeder







Continuity and efficiency

- Plant breeding is a long term and cyclical.
- Successful plant breeding programs require continuity.
- Plant breeding, unlike other types of research, cannot be started and stopped based on three year granting cycles.
- *Once the pipeline is empty it takes years to refill.*

What can public plant breeders do for us?

- Independence (e.g. risky, very long term projects, low seed value)
- Public service (work directly with underserved markets and farmers)
- Farmer choice and profitability
- Food security (e.g. exotic germplasm, local plant breeding)
- Sustainability (e.g. low value perennials, local)
- Education of plant breeders and geneticists
- Insurance (need active breeding programs to respond to emerging threats)

Why public breeders?

- Independence: Ideally, public plant breeders have the freedom to pursue long term research and far out ideas. Adequate funding allows them do research with low financial return in the results of their breeding program. Therefore decisions should be made in the public interest.
- Public service: Plant breeders actually developing cultivars adapted to the local environment must be familiar with the needs and challenges of the local farmers and consumers

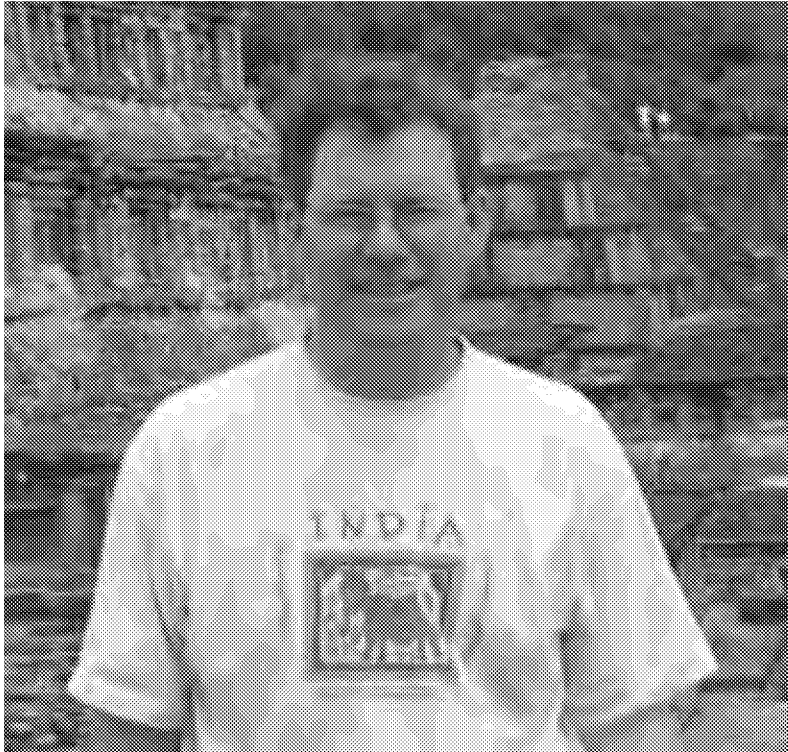
Independence

- Breeder/Geneticist at the University of Illinois
- Discovered the utility of *sh2* for sweet corn and bred the first supersweet hybrid
- Seed companies initially rejected idea.
- Created a revolution worth billions.



John Laughnan

Independence



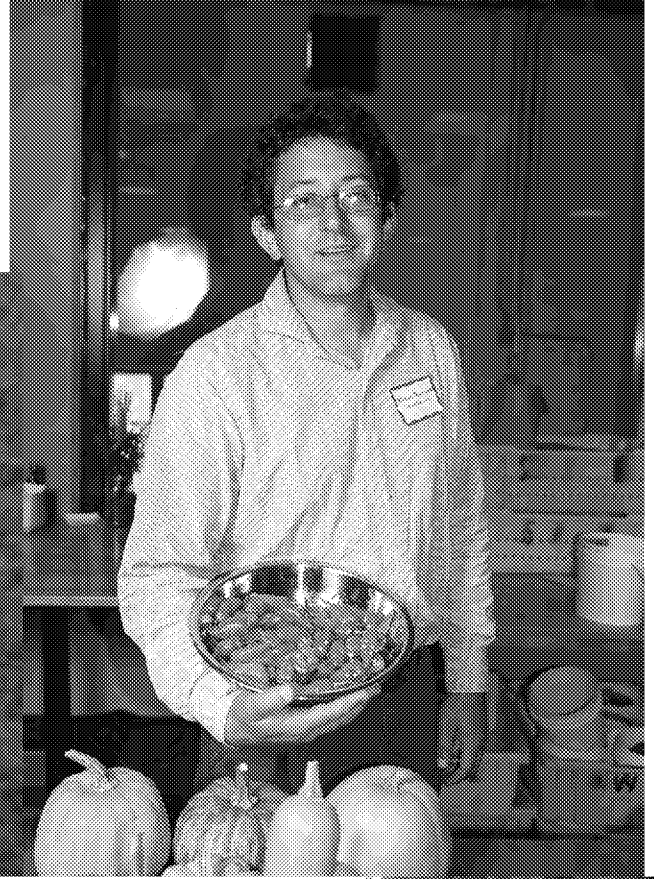
INGREDIENTS: SORBITOL, GUM BASE, XYLITOL, GLYCERIN, NATURAL AND ARTIFICIAL FLAVORING, MANNITOL; LESS THAN 2% OF: ACESULFAME POTASSIUM, ASPARTAME, BHT (TO MAINTAIN FRESHNESS), BLUE 1 LAKE, SOY LECITHIN, SUCRALOSE AND YELLOW 5 LAKE.

PHENYLKETONURICS:
CONTAINS PHENYLALANINE

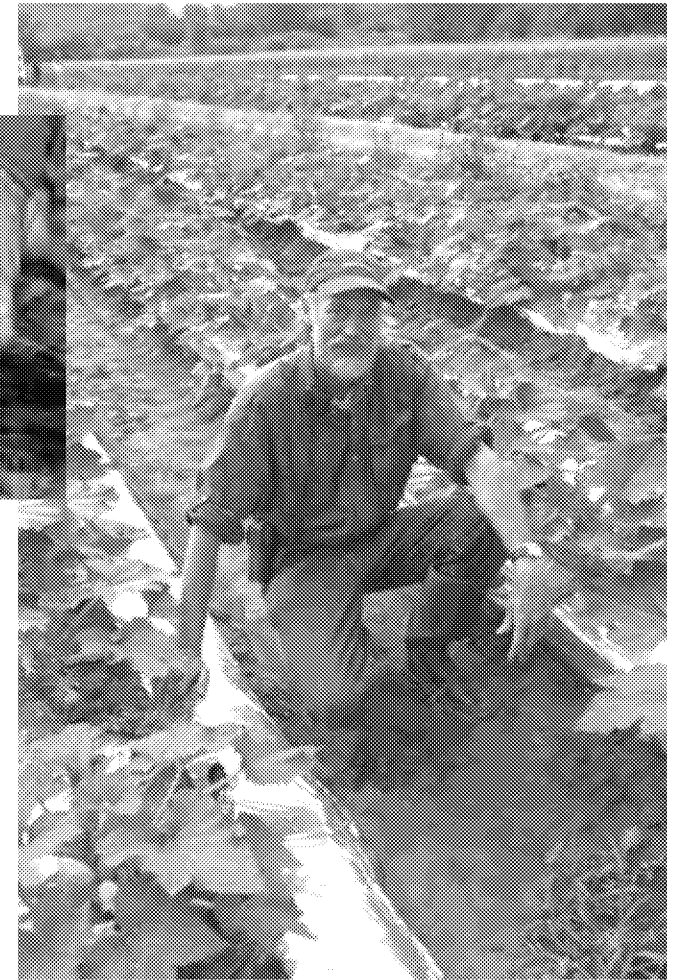
**Jim Holland, USDA Breeder at NCSU,
breeding corn for Phenylketonurionics**

Service

Michael Mazouek



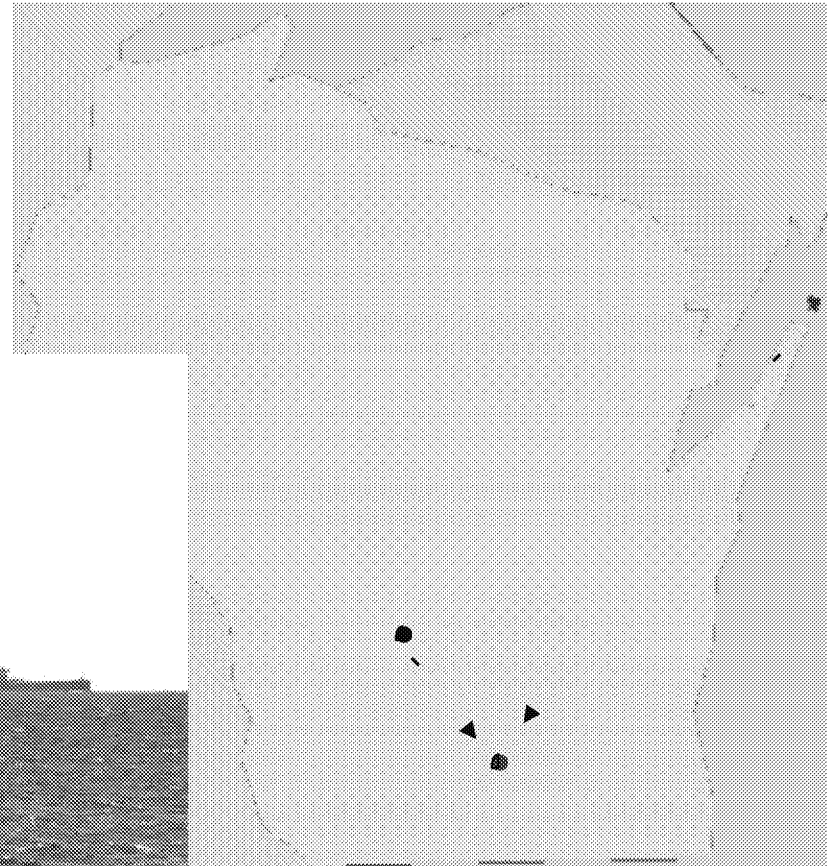
Irwin's golden beets and Harmony Valley Farm





Value added chain

wheat to fermentation tanks



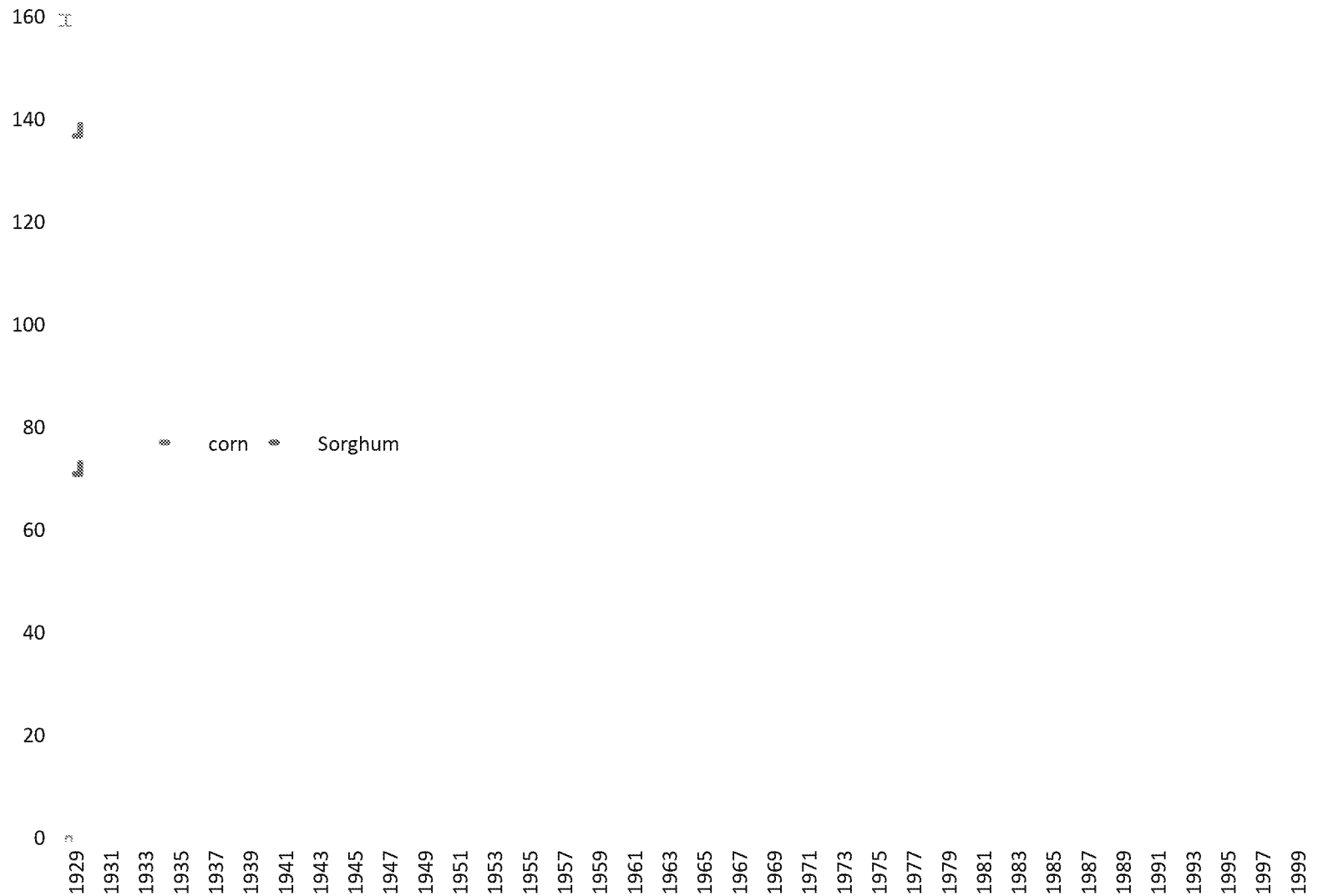
Food Security and Sustainability

- Diversity at multiple levels leads to a healthier agriculture. Genetic diversity, crop diversity, cropping system diversity.
- As the seed industry consolidates, some areas receive reduced attention.
- Farmers in these regions or systems are left to use old cultivars or ones that were developed elsewhere and just happened to fit their needs.
- This has negative effects on the competitiveness of those farms, thereby decreasing diversity at the level of community.
- Numerous public breeders working in diverse ecosystems with diverse crops needed to increase diversity at all levels.

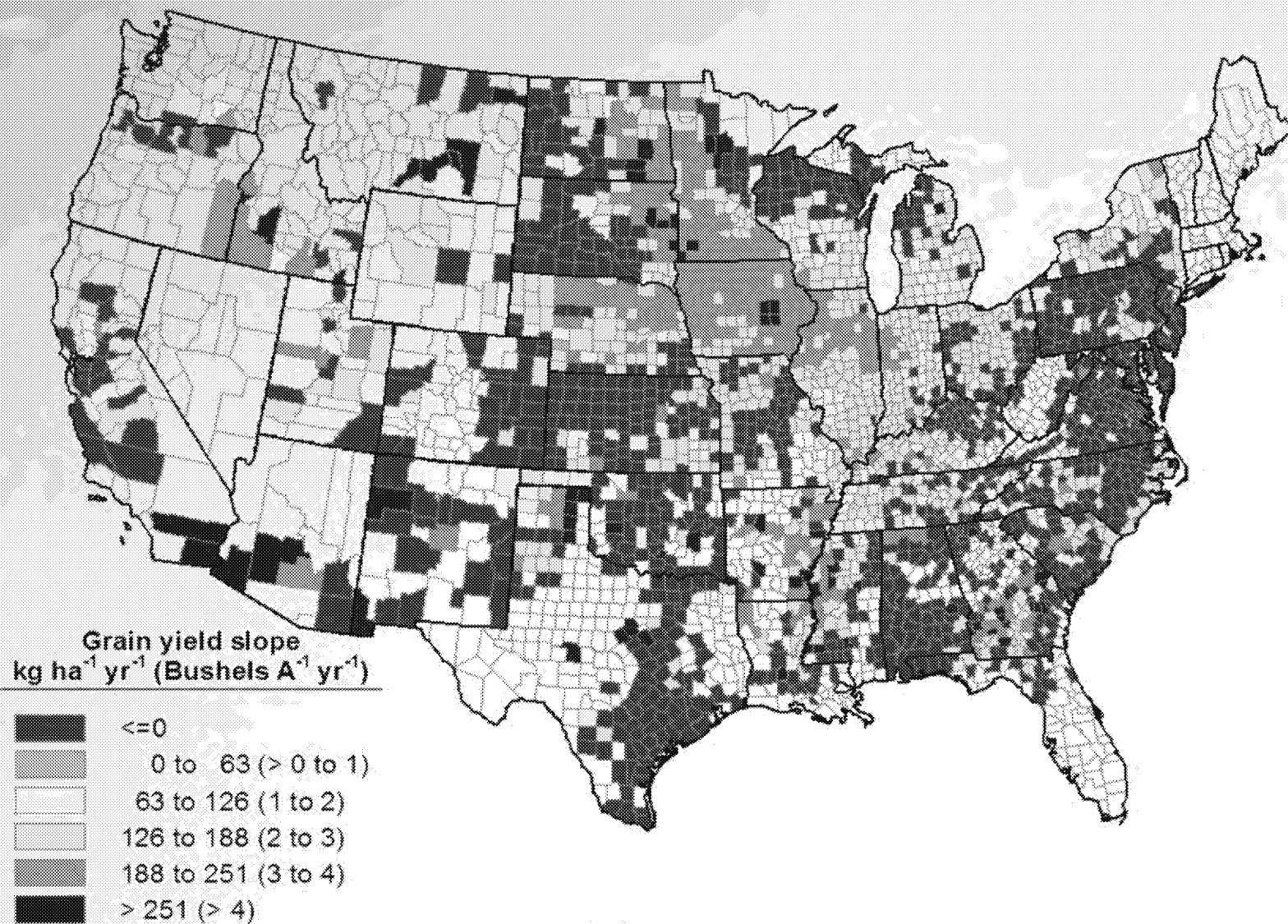
Farmer choice and profitability

- Farming is an economic endeavor
- Farmers must choose varieties that will make them competitive.
- Neglected crops become less competitive relative to highly bred crops.
- Reducing the complexity of farming systems and increasing monoculture.

Yield of corn and sorghum 1929-2000



Corn yield change over time for U.S. counties 1990 to 2009



Food security

- Wisconsin exotic sweet corn breeding
- Once use of exotics shunned by companies
- Uses non-sweet germplasm to develop improved hybrids
- High levels of resistance to major diseases.
- Now used by all major companies



Sustainability

Mike Casler's hybrid switchgrass



- Started 20 years before use as a biofuel considered
- Production warm season forage.
- Excellent long-lived perennial

Education

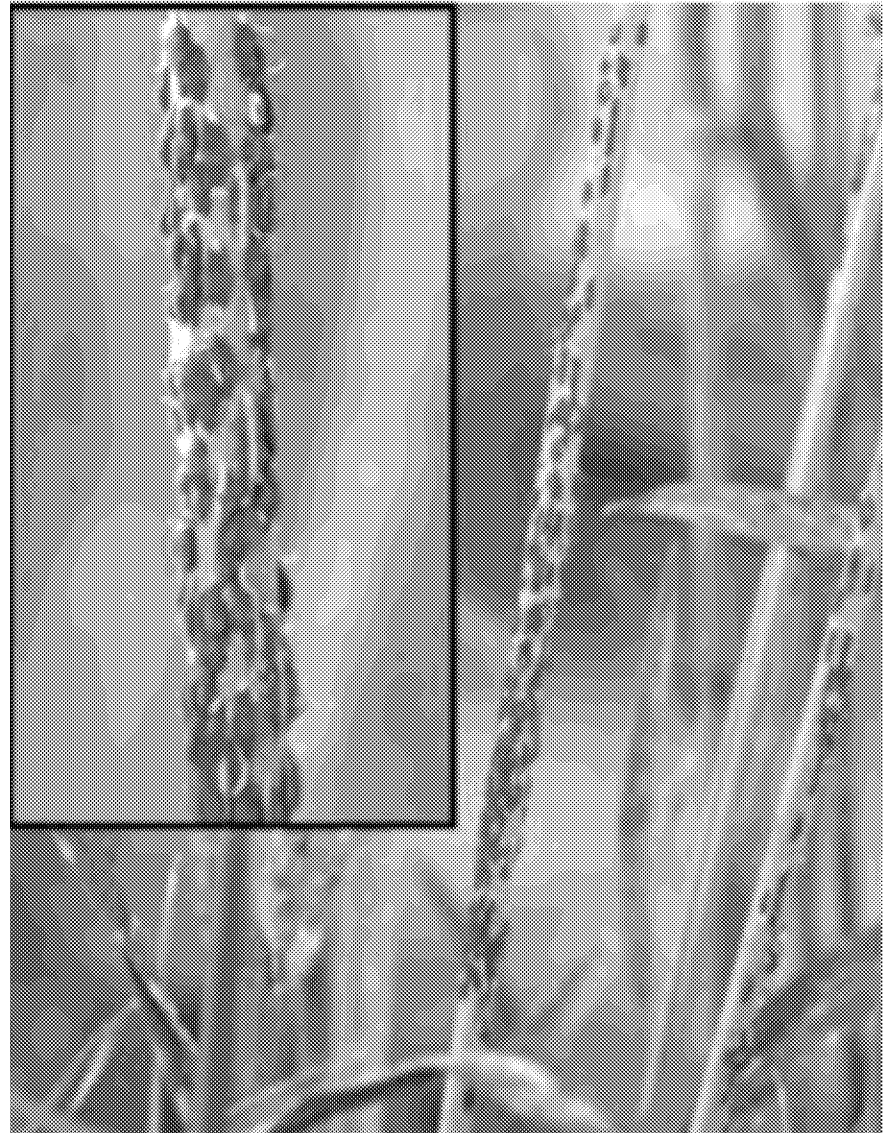
- Best place to train plant breeders is in active productive programs
- Eight private : 0 public



Insurance (Food Security)

- “Plant breeding programs are a form of social insurance... In times of crisis, when new diseases appear or old ones evolve and explode with virulent outbreaks plant breeders are called upon to rescue crops, industries and people.”

Cary Fowler



Ug99 wheat rust

Conclusion

- Public Plant Breeding programs are a critical part of the US seed system
- Public programs are at risk of extinction
- Public and private can complement, not compete with one another
- Critical gaps currently exist.



How can we reverse course?

- Increase formula funds to rebuild capacity for plant breeding at LGUs
- Increase portion of NIFA-AFRI dedicated to plant breeding.
- Build on success of innovative programs that fill regional needs and orphan crops.
- Empower farmers and end users to collaborate with plant breeders through programs like SARE.